

**IN THE UNITED STATES DISTRICT COURT
FOR THE EASTERN DISTRICT OF TEXAS
MARSHALL DIVISION**

JAWBONE INNOVATIONS, LLC,	§	Case No.
	§	
Plaintiff,	§	<u>JURY TRIAL DEMANDED</u>
	§	
v.	§	
	§	
AMAZON.COM, INC. and AMAZON.COM SERVICES, INC.,	§	
	§	
Defendants.	§	
	§	

COMPLAINT FOR PATENT INFRINGEMENT

Plaintiff Jawbone Innovations, LLC (“Jawbone” or “Plaintiff”) for its Complaint against Defendants Amazon.com, Inc. and Amazon.com Services, Inc. (collectively “Amazon” or “Defendants”), for patent infringement under 35 U.S.C. § 271 and alleges as follows:

THE PARTIES

1. Jawbone is a corporation organized and existing under the laws of the State of Texas, with a place of business located at 104 East Houston Street, Suite 165, Marshall, Texas 75670.

2. Upon information and belief, Defendant Amazon.com, Inc. is a corporation organized and existing under the laws of the State of Delaware, with its principal place of business located at 410 Terry Avenue North, Seattle, Washington 98109-5210.

3. Upon information and belief, Defendant Amazon.com Services, Inc. is a corporation organized and existing under the laws of the State of Delaware, which is headquartered at 410 Terry Avenue North, Seattle, Washington 98109-5210.

4. Upon information and belief, Amazon.com, Inc. is the ultimate parent of Amazon.com Services, Inc. Amazon is a leading manufacturing and seller of virtual assistant smart speakers in the world and in the United States.

JURISDICTION AND VENUE

5. This is an action for patent infringement arising under the patent laws of the United States, 35 U.S.C. §§ 1, *et seq.* This Court has jurisdiction over this action pursuant to 28 U.S.C. §§ 1331 and 1338(a).

6. This Court has personal jurisdiction over Amazon. Amazon regularly conducts business and has committed acts of patent infringement and/or has induced acts of patent infringement by others in this District and/or has contributed to patent infringement by others in this District, the State of Texas, and elsewhere in the United States.

7. Venue is proper in this Judicial District pursuant to 28 U.S.C. §§ 1391 and 1400(b) because, among other things, upon information and belief Amazon maintains regular and established physical places of business in Texas and in the Eastern District of Texas, directly or through intermediaries.

8. Upon information and belief, Amazon, by itself and/or through its subsidiaries, operates one or more “Fulfillment Centers” within this Judicial District including, at least, a Fulfillment Center located in Denton County at 15201 Heritage Parkway, Fort Worth, Texas 76177.

9. Amazon has admitted that it operates an Amazon Fulfillment Center within this District.¹

¹ See Exhibit A at ¶¶ 7 and 16; *see also Vocalife LLC v. Amazon.com, Inc. and Amazon.com, LLC*, Case No. 2:19-cv-00123-JRG, Dkt. 226 at 2 (“Amazon admits that subsidiaries of Amazon.com, Inc. operate a fulfillment center in this district.”).

10. Amazon has admitted that it employs information technology personnel at its Fulfillment Center in Denton County, which is in this District.²

11. Upon information and belief, Amazon has a regular and established place of business in this Judicial District including, at least, a distribution facility located at 1649 W. Frankford Road, Carrollton, Texas 75007, Amazon “lockers,”³ employees, and other business.

12. Upon information and belief, Amazon has a regular and established place of business in this Judicial District including, at least, a Fulfillment Center located in Denton County at 4121 International Parkway, Carrollton, Texas, 75007.

13. Upon information and belief, Amazon has property in Denton County appraised on the property tax rolls by Denton County at \$286,857,725,⁴ \$137,021,802,⁵ and \$27,429,176.⁶ Amazon and/or its subsidiaries employ individuals within this Judicial District responsible for the distribution of its products including those accused of infringement below.

14. Amazon offers its products and/or services, including those accused of infringement below, to customers and potential customers located in Texas and in this District.

² *Id.* at ¶ 20.

³ Amazon operates “Amazon Hub Lockers” in at least the following locations: Plano, Carrollton, The Colony, and Lewisville. *See* <https://www.amazon.com/gp/css/account/address/view.html>

⁴ *See* details regarding 700 Westport Parkway, Fort Worth, Texas 76177 available at [https://taxweb.dentoncounty.gov/Search/Results?Query.SearchField=2&Query.PropertyType=&Query.PayStatus=Both&Query.SearchText=amazon&Query.SearchAction="](https://taxweb.dentoncounty.gov/Search/Results?Query.SearchField=2&Query.PropertyType=&Query.PayStatus=Both&Query.SearchText=amazon&Query.SearchAction=); *see also* <https://taxweb.dentoncounty.gov/Accounts/AccountDetails?taxAccountNumber=13844849TAR>.

⁵ *See* details regarding 15201 Heritage Parkway, Fort Worth, Texas 76177, available at [https://taxweb.dentoncounty.gov/Search/Results?Query.SearchField=2&Query.PropertyType=&Query.PayStatus=Both&Query.SearchText=amazon&Query.SearchAction="](https://taxweb.dentoncounty.gov/Search/Results?Query.SearchField=2&Query.PropertyType=&Query.PayStatus=Both&Query.SearchText=amazon&Query.SearchAction=) and <https://taxweb.dentoncounty.gov/Accounts/AccountDetails?taxAccountNumber=699143DEN>.

⁶ *See* details regarding 4121 International Parkway, Carrollton, Texas 75007, available at [https://taxweb.dentoncounty.gov/Search/Results?Query.SearchField=2&Query.PropertyType=&Query.PayStatus=Both&Query.SearchText=amazon&Query.SearchAction="](https://taxweb.dentoncounty.gov/Search/Results?Query.SearchField=2&Query.PropertyType=&Query.PayStatus=Both&Query.SearchText=amazon&Query.SearchAction=) and <https://taxweb.dentoncounty.gov/Accounts/AccountDetails?taxAccountNumber=776100DEN>.

15. Amazon is subject to personal jurisdiction in this District, has a regular and established place of business in this District including Amazon Fulfillment Centers in this District and throughout Texas, has purposely transacted business involving the Accused Products in this District, including sales to one or more customers in Texas, has employees in this District, and certain of the acts complained of herein occurred in this District.

16. Amazon is subject to this Court's jurisdiction pursuant to due process and/or the Texas Long Arm Statute due at least to its substantial business in this State and District, including (a) at least part of its past infringing activities, (b) regularly doing or soliciting business in Texas, and/or (c) engaging in persistent conduct and/or deriving substantial revenue from goods and services provided to customers in Texas.

FACTUAL BACKGROUND

17. On September 13, 2011, the United States Patent and Trademark Office duly and legally issued U.S. Patent No. 8,019,091 (the "'091 Patent") entitled "Voice Activity Detector (VAD)-Based Multiple-Microphone Acoustic Noise Suppression." A true and correct copy of the '091 Patent is attached hereto as Exhibit B.

18. On July 17, 2007, the United States Patent and Trademark Office duly and legally issued U.S. Patent No. 7,246,058 (the "'058 Patent") entitled "Detecting Voiced and Unvoiced Speech Using Both Acoustic and Nonacoustic Sensors." A true and correct copy of the '058 Patent is attached hereto as Exhibit C.

19. On October 2, 2012, the United States Patent and Trademark Office duly and legally issued U.S. Patent No. 8,280,072 (the "'072 Patent") entitled "Microphone Array with Rear Venting." A true and correct copy of the '072 Patent is attached hereto as Exhibit D.

20. On November 17, 2012, the United States Patent and Trademark Office duly and legally issued U.S. Patent No. 8,321,213 (the “’213 Patent”) entitled “Acoustic Voice Activity Detection (AVAD) for Electronic Systems.” A true and correct copy of the ’213 Patent is attached hereto as Exhibit E.

21. On December 4, 2012, the United States Patent and Trademark Office duly and legally issued U.S. Patent No. 8,326,611 (the “’611 Patent”) entitled “Acoustic Voice Activity Detection (AVAD) for Electronic Systems.” A true and correct copy of the ’611 Patent is attached hereto as Exhibit F.

22. On September 15, 2020, the United States Patent and Trademark Office duly and legally issued U.S. Patent No. 10,779,080 (the “’080 Patent”) entitled “Dual Omnidirectional Microphone Array.” A true and correct copy of the ’080 Patent is attached hereto as Exhibit G.

23. On September 14, 2021, the United States Patent and Trademark Office duly and legally issued U.S. Patent No. 11,122,357 (the “’357 Patent”) entitled “Forming Virtual Microphone Arrays Using Dual Omnidirectional Microphone Array (DOMA).” A true and correct copy of the ’357 Patent is attached hereto as Exhibit H.

24. On June 18, 2013, the United States Patent and Trademark Office duly and legally issued U.S. Patent No. 8,467,543 (the “’543 Patent”) entitled “Microphone and Voice Activity Detection (VAD) Configurations for Use with Communications Systems.” A true and correct copy of the ’543 Patent is attached hereto as Exhibit I.

25. Jawbone is the sole and exclusive owner of all right, title, and interest to and in the ’091 Patent, ’058 Patent, ’072 Patent, ’213 Patent, ’611 Patent, ’080 Patent, ’357 Patent, and ’543 Patent, (together, the “Patents-in-Suit”), and holds the exclusive right to take all actions necessary to enforce its rights to the Patents-in-Suit, including the filing of this patent infringement lawsuit.

Jawbone also has the right to recover all damages for past, present, and future infringement of the Patents-in-Suit and to seek injunctive relief as appropriate under the law.

26. The technology of the Patents-in-Suit was developed by Jawbone, Inc, which was originally founded in 1998 as AliphCom, Inc. (“AliphCom”). AliphCom set out to develop a noise reducing headset that would allow soldiers to communicate better in combat conditions. In 2002, AliphCom won a contract with the Defense Advanced Research Projects Agency to research noise suppression techniques for the United States military.

27. AliphCom launched a mobile headset called the “Jawbone” in 2004. The “Jawbone” included the innovative noise-suppression technology that AliphCom developed for the military.⁷ This technology virtually eliminated background noise while increasing the volume of the speakers’ voices. AliphCom followed with a Bluetooth version of the “Jawbone” in 2008 which was sold in the Apple Store.

28. On the heels of the success of the “Jawbone” products, AliphCom changed its name to Jawbone, Inc. in 2011 and later expanded its product offerings into Bluetooth speakers and wearables, such as health tracking devices. Unfortunately, due to the intensely competitive marketplace, Jawbone, Inc. was forced into liquidation in 2017.

29. Following Jawbone, Inc.’s liquidation “[a] host of technology companies including Apple, Samsung, Google, LG and Fitbit [were] identified as potential buyers of Jawbone’s US Patents.”⁸ Upon information and belief, Envision IP (and other parties) contacted Amazon regarding the value of the Asserted Patents, including regarding Amazon’s infringement of the

⁷ See <https://www.wired.com/2004/09/military-headset-reaches-masses/>

⁸ See <https://www.worldipreview.com/news/apple-google-and-fitbit-touted-to-acquire-jawbone-patents-14322>; <https://www.gipi.com.br/en/apple-google-and-fitbit-touted-to-acquire-jawbone-patents/>; see also <http://patentvue.com/2017/07/11/jawbone-patents-could-be-leveraged-by-a-competitor/>

Asserted Patents. Upon information and belief, Amazon was notified that Amazon smart home devices, including smart speakers, smart displays, and hands-free streaming devices, and ear buds (the “Accused Products”) infringe the Patents-in-Suit, and/or otherwise became aware of the Patents-in-Suit and recognized that the Accused Products infringe the Patents-in-Suit at least as of 2017.

INFRINGEMENT ALLEGATIONS

30. The '091 and '058 Patents generally describes acoustic noise suppression with a voice activity detector that senses vibration in human tissue associated with voicing activity. The technology of the '091 was developed by Dr. Gregory C. Burnett and Eric F. Breitfeller. The technology of the '058 Patent was developed by Dr. Gregory C. Burnett. The '091 and '058 Patents also describes techniques for generating transfer functions and cross correlations representative of acoustic signals when voicing activity is absent, providing improved noise suppression. Some embodiments of the invention include a microphone array with one microphone which primarily captures sound (e.g., speech), and one which primarily captures unwanted noise, both of which provide signals to a noise removal algorithm.

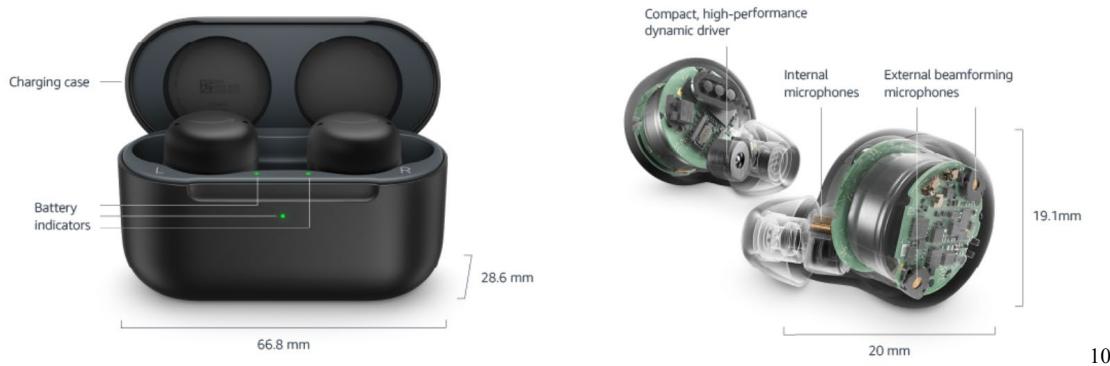
31. The noise removal algorithm may also receive physiological information from a voice activity detector (e.g., an accelerometer) to detect when a user is speaking. Such a voice activity detection signal may be assumed to be perfectly accurate, yielding substantial improvements when applied to the noise removal algorithm. For example, the noise removal algorithm may remove noise by calculating one transfer function when the system is certain that only noise is being received, and another transfer function when the system is certain that speech is being produced. The noise removal algorithm may further improve noise suppression in situations with multiple noise sources by combining such transfer functions into additional transfer

functions representative of a ratio of energies received at different microphones. By taking advantage of perfect voice activity detection and transfer functions representative of a ratio of energies received at different microphones, the noise removal algorithm may effectively remove noise from a signal no matter how many noise sources are present. The invention thereby provides significant advantages for noise suppression systems, particularly in detecting, transmitting, or recording speech.

32. Amazon has manufactured, used, marketed, distributed, sold, offered for sale, exported from, and imported into the United States, products that infringe the '091 and '058 Patents. For example, noise suppression techniques are incorporated into voice activity detection devices including, but not limited to, Amazon Echo Buds. Each earbud of the Amazon Echo Buds includes "2 external beamforming microphones" and an accelerometer which is, upon information and belief, used to detect human tissue vibration associated with voice activity. Each earbud of the Amazon Echo Buds further comprises a Realtek RTL8763C Bluetooth System on Chip with integrated Audio Codec and/or NXP Digital Signal Processor.⁹ Upon information and belief, the beamformed microphones and accelerometer of the Echo Buds work in tandem to suppress noise while detecting speech. Upon information and belief, the beamforming microphone array of the Echo Buds generates transfer functions representative of a ratio of energy of the acoustic signals received at each microphone.

⁹ <https://www.amazon.com/All-new-Echo-Buds/dp/B085WV7635?th=1>

Technical details

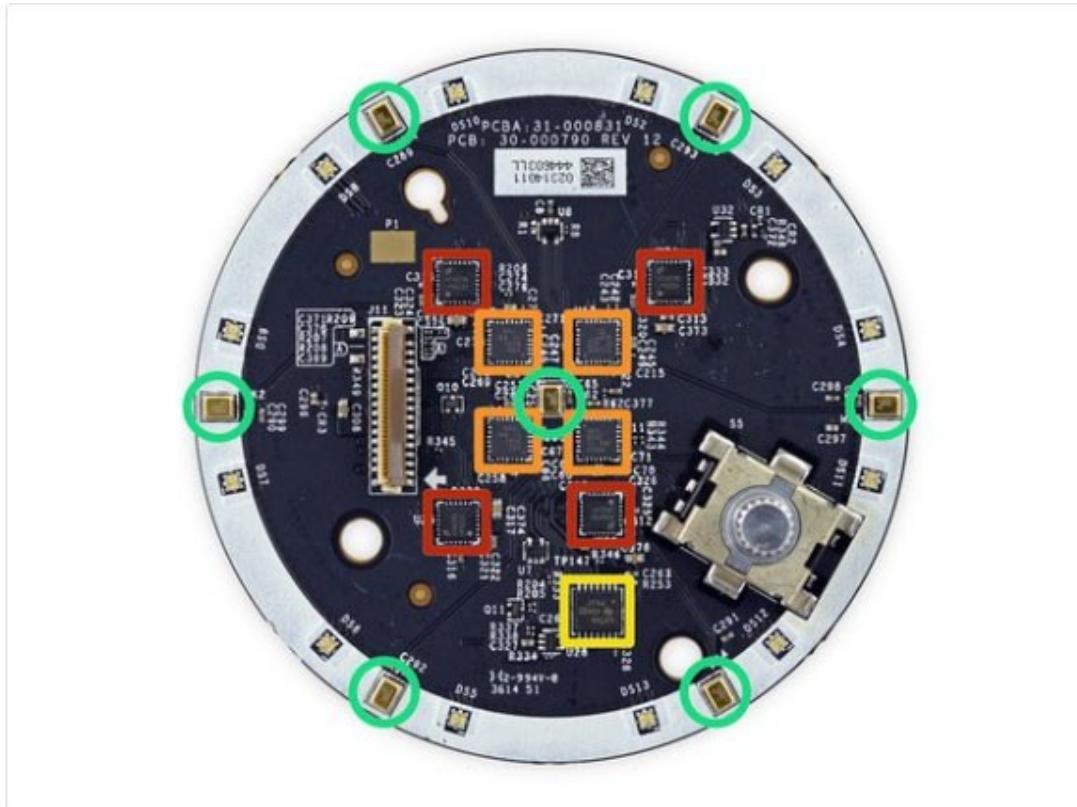


33. The '072 Patent generally describes acoustic noise suppression with an array of physical microphones which forms an array of virtual microphones. The technology was developed by Dr. Gregory C. Burnett. The '072 Patent also describes noise suppression with physical omnidirectional microphones and virtual directional microphones. In some embodiments of the invention, a greater number of physical microphones may be used to form a smaller number of virtual microphones which are combined into an output signal with less acoustic noise than the received acoustic signals. The resulting virtual microphones may further be combined by applying transfer functions representative of a ratio of energies between physical microphones, outputting a signal with greatly reduced noise. The invention provides significant advantages for noise suppression systems, particularly in detecting, transmitting, or recording speech.

34. Amazon has manufactured, used, marketed, distributed, sold, offered for sale, exported from, and imported into the United States, products that infringe the '072 Patent. For example, this functionality is included and utilized in Amazon products with omnidirectional physical MEMS microphones which form virtual beamformed microphones including, but not limited to, the Amazon Echo. For example, upon information and belief, at least the Amazon Echo

¹⁰ <https://www.amazon.com/All-new-Echo-Buds/dp/B085WV7635?th=1>

Gen 1 comprises an array of at least seven physical microphones and six beamformed microphones, the outputs of which are combined to reduce the noise of a signal. Amazon states that the Echo uses “beam forming to isolate the user’s voice from background noise and deliver high-quality input for processing.”¹¹



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¹¹ <https://developer.amazon.com/blogs/alexa/post/b80b4669-2675-4752-a171-fa6aaa7e5aff/bringing-far-field-voice-technology-from-the-amazon-echo-to-third-party-devices>

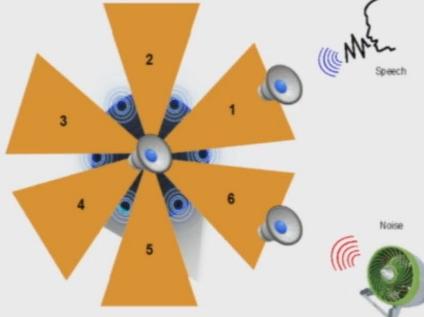
¹² <https://www.ifixit.com/Teardown/Amazon+Echo+Teardown/33953>; annotations in the image originate from <https://www.ifixit.com/Teardown/Amazon+Echo+Teardown/33953>. Green circles indicate the microphones located in Amazon's Echo product.

SIGNAL PROCESSING

Beamforming

Acoustic echo cancellation (AEC)

- Applied to each beam
- Reduces echo of device playback
- Before AEC: 
- After AEC: 



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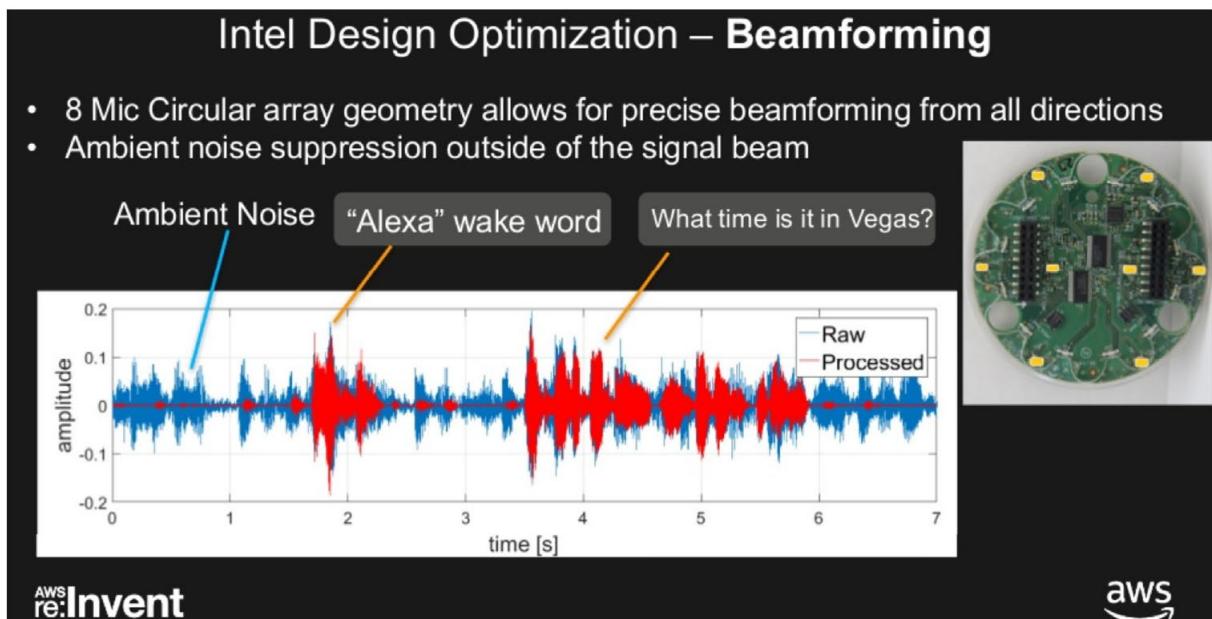
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35. The '611 and '213 Patents generally describe acoustic voice activity detection based on a ratio of energies between virtual microphones formed by an array of physical microphones. The technology of the '611 and '213 Patents was developed by Dr. Gregory C. Burnett, Nicholas Petit, and Zhinian Jing. In some embodiments of the invention, a first virtual microphone may be generated by summing the outputs of a first physical microphone processed with a delay filter, and a second physical microphone processed with a calibration filter and an adaptive filter, while a second virtual microphone may be generated by summing the outputs of a first physical microphone processed with an adaptive filter and a delay filter, and a second physical microphone processed with a calibration filter. Accordingly, the invention provides virtual microphones with similar noise response magnitudes, but very dissimilar speech response

¹³ Screen capture of AWS re: Invent 2017: The Science behind the Alexa Prize: Meeting the AI Challenges (ALX320) at 20:07, video available at <https://www.youtube.com/watch?v=pn5QJQZjGpM>

magnitudes. A ratio of energies between the virtual microphones may further be compared to a threshold to detect when voicing activity occurring. The invention of the '611 and '213 Patents provides significant improvements in noise suppression, including by enabling accurate voice activity detection with a microphone array.

36. Amazon has manufactured, used, marketed, distributed, sold, offered for sale, exported from, and imported into the United States, products that infringe the '213 and '611 Patents. For example, this functionality is included and utilized in Amazon products which use virtual microphones formed by physical microphones to detect a wake word including, but not limited to, Echo smart speakers. For example, upon information and belief, the Echo forms an array of virtual microphones, such as by beamforming. Upon information and belief, the Amazon Echo detects user speech, such as an "Alexa" wake word, by comparing a ratio of energies (e.g. amplitudes), of the beamformed microphones to a threshold.



¹⁴ <https://www.slideshare.net/AmazonWebServices/designing-farfield-speech-processing-systems-with-intel-and-amazon-alexa-voice-service-alx305-reinvent-2017>

37. The '080 Patent generally describes noise suppression with an array of omnidirectional microphones that form virtual microphones with a similar noise response and a dissimilar speech response. The technology of the '080 Patent was developed by Dr. Gregory C. Burnett. The '080 Patent also describes a dual omnidirectional microphone array that forms two distinct virtual microphones that can be paired with an adaptive filter and/or VAD algorithm to significantly reduce noise without distorting speech, thereby improving the signal-to-noise ratio of the desired speech. In some embodiments, output of each physical microphone can be delayed, multiplied by a gain, and summed with the other in order to form at least one virtual microphone, which may be paired with an adaptive filter and/or VAD algorithm to suppress noise. The invention of the '080 Patent provides substantial advantages for noise suppression systems, particularly in detecting, transmitting, or recording speech.

38. Amazon has manufactured, used, marketed, distributed, sold, offered for sale, exported from, and imported into the United States, products that infringe the '080 Patent. For example, this functionality is included and utilized in Amazon products with omnidirectional physical MEMS microphones which form virtual beamformed microphones including, but not limited to, Amazon ear buds and smart home devices. For example, upon information and belief, each Echo Bud earbud comprises two physical omnidirectional microphones, and a processing component coupled to the microphone array generating two beamformed virtual microphones (e.g. a Realtek RTL8763C Bluetooth System on Chip with integrated Audio Codec and/or NXP Digital Signal Processor).¹⁵ For example, upon information and belief, each Amazon Echo smart speaker comprises at least two physical omnidirectional microphones, and a processing unit coupled to the microphone array generating at least two beamformed virtual microphones (e.g. a Texas

¹⁵ <https://www.amazon.com/All-new-Echo-Buds/dp/B085WV7635?th=1>

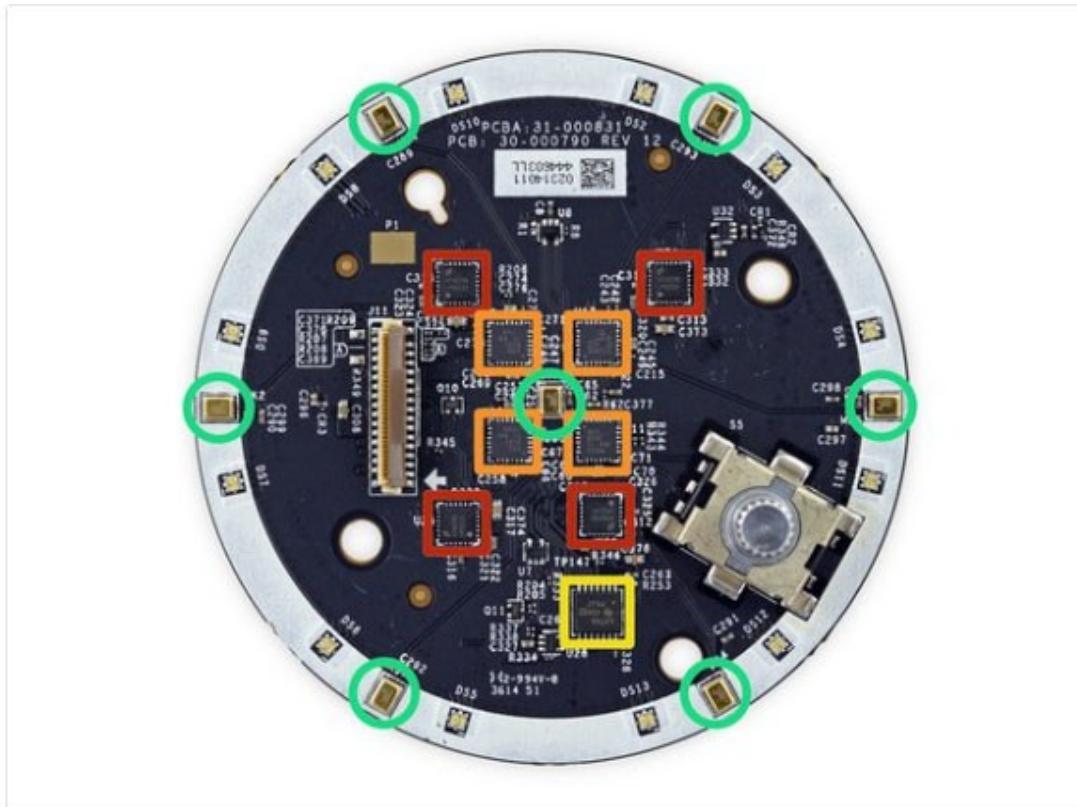
Instruments DM3725CUS100 Digital Media Processor).¹⁶ On information and belief, the processing component generates beamformed microphones with different first and second combinations of output signals from the physical microphone array, wherein the virtual microphones have a similar noise response and a dissimilar speech response.

39. The '357 and '691 Patents generally describe acoustic noise suppression with an array of physical microphones which forms an array of virtual microphones. The technology was developed by Dr. Gregory C. Burnett. The '357 and '691 Patents also describe noise suppression with physical omnidirectional microphones and virtual directional microphones. The physical and/or virtual microphone signals may be combined by filtering and summing in the time domain to apply a varying linear transfer function, suppressing noise in the output signal. The invention provides significant advantages for noise suppression systems, particularly in detecting, transmitting, or recording speech.

40. Amazon has manufactured, used, marketed, distributed, sold, offered for sale, exported from, and imported into the United States, products that infringe the '357 and '691 Patents. For example, this functionality is included and utilized in Amazon products with physical MEMS microphones which form virtual beamformed microphones including, but not limited to, Amazon ear buds and smart home devices. For example, upon information and belief, the Amazon Echo Buds comprise arrays of physical microphones, the outputs of which are combined into beamformed microphones to reduce the noise of a signal. On information and belief, the Echo Buds combine the outputs, the signals generated by the beamforming microphone array of each earbud to further reduce noise. Similarly, upon information and belief, Amazon Echo smart

¹⁶ <https://www.ifixit.com/Teardown/Amazon+Echo+Teardown/33953>

speakers comprise arrays of physical microphones, the outputs of which are combined into beamformed microphones to reduce the noise of a signal.¹⁷



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¹⁷ <https://developer.amazon.com/blogs/alexa/post/b80b4669-2675-4752-a171-fa6aaa7e5aff/bringing-far-field-voice-technology-from-the-amazon-echo-to-third-party-devices>

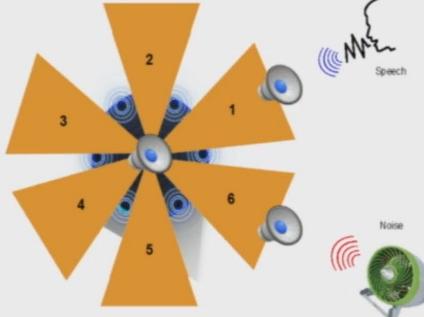
¹⁸ <https://www.ifixit.com/Teardown/Amazon+Echo+Teardown/33953>; Annotations in the image originate from <https://www.ifixit.com/Teardown/Amazon+Echo+Teardown/33953>. Green circles indicate the microphones located in Amazon's Echo product.

SIGNAL PROCESSING

Beamforming

Acoustic echo cancellation (AEC)

- Applied to each beam
- Reduces echo of device playback
- Before AEC: 
- After AEC: 



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41. The '543 Patent generally describes communications systems comprising a voice detection subsystem and a denoising subsystem. The technology of the '543 Patent was developed by Dr. Gregory C. Burnett, Nicholas Petit, Alexander M. Asseily, and Andrew E. Einaudi. The '543 Patent also describes microphone configurations wherein a first microphone is oriented toward a talker's mouth, and a second microphone is oriented away from a talker's mouth, such that the denoising subsystem may subtract noise associated with noise from an acoustic signal that includes speech and noise. In some embodiments of the invention, the denoising system selects a denoising method appropriate to data of at least one frequency subband of acoustic signals, generates noise waveform estimate, and subtracts the noise waveform estimate from signals including speech and noise when the voice detection subsystem indicates voicing activity is

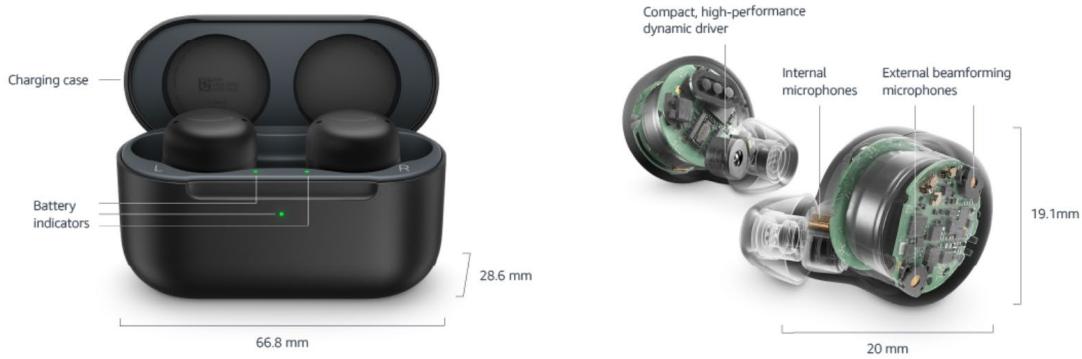
¹⁹ Screen capture of AWS re: Invent 2017: The Science behind the Alexa Prize: Meeting the AI Challenges (ALX320) at 20:07, video available at <https://www.youtube.com/watch?v=pn5QJQZjGpM>

occurring. The invention provides significant advantages for noise suppression systems, particularly in detecting, transmitting, or recording speech.

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At least one microphone of each earbud of the Amazon Echo Buds (e.g., the lower microphone) is oriented towards a user's mouth, while at least one microphone is oriented away from a user's mouth. On information and belief, the accelerometers of the Echo Buds detect vibration in human tissue and work in tandem with beamforming microphones to suppress noise.

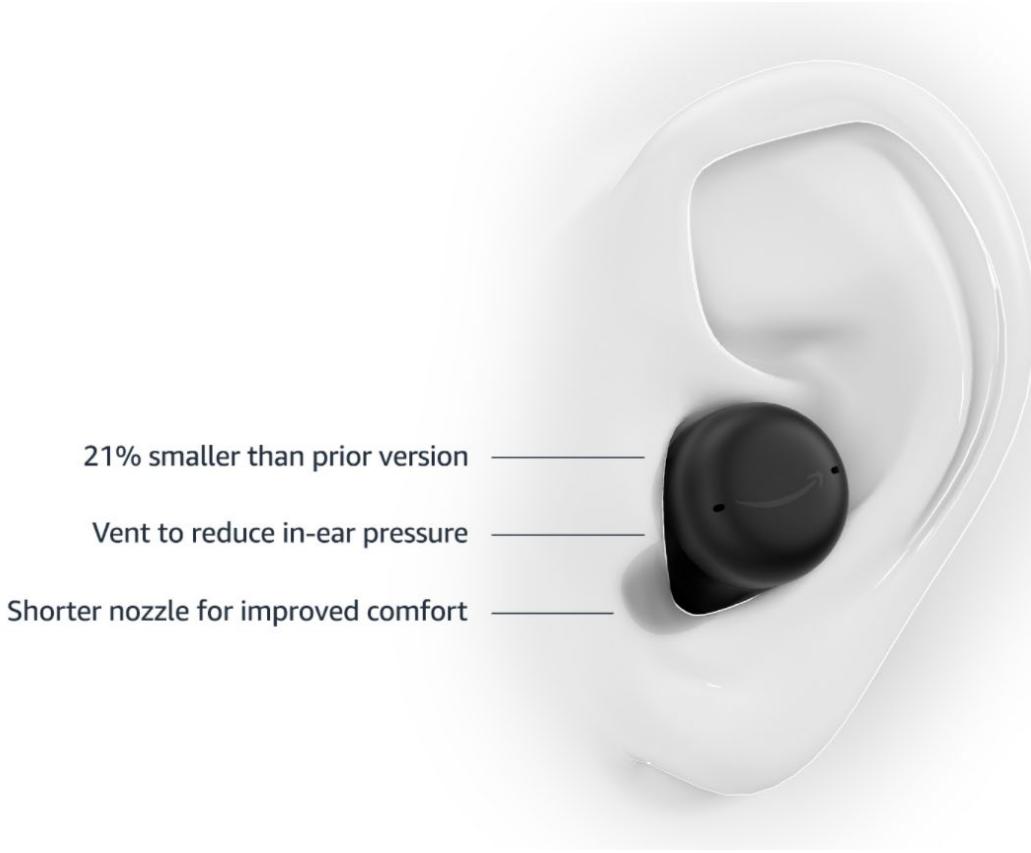
Technical details



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²⁰ <https://www.amazon.com/All-new-Echo-Buds/dp/B085WV7635?th=1>

²¹ <https://www.amazon.com/All-new-Echo-Buds/dp/B085WV7635?th=1>



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43. Amazon has infringed and is continuing to infringe the Patents-in-Suit by making, using, selling, offering to sell, and/or importing, and by actively inducing others to make, use, sell, offer to sell and/or importing, Accused Products that comprise and utilize infringing microphone and/or wireless proximity sensing functionality. The Accused Products include, but are not limited to, all versions and variants of Echo smart speakers, Echo Show smart displays, Fire TV Cube, and Echo buds.

44. Jawbone has at all times complied with the marking provisions of 35 U.S.C. § 287 with respect to the Patents-in-Suit. On information and belief, prior assignees and licensees have also complied with the marking provisions of 35 U.S.C. § 287.

²²<https://www.amazon.com/Echo-Buds-2nd-Gen-Wireless-earbuds-with-active-noise-cancellation- and-Alexa/dp/B085WTYQ4X>

COUNT I
(Infringement of the '091 Patent)

45. Paragraphs 1 through 44 are incorporated by reference as if fully set forth herein.

46. Jawbone has not licensed or otherwise authorized Amazon to make, use, offer for sale, sell, or import any products that embody the inventions of the '091 Patent.

47. Amazon has and continues to directly infringe the '091 Patent, either literally or under the doctrine of equivalents, without authority and in violation of 35 U.S.C. § 271, by making, using, offering to sell, selling, and/or importing into the United States products that satisfy each and every limitation of one or more claims of the '091 Patent. Upon information and belief, these products include at least the Accused Products, such as those which comprise a microphone array and a voice activity detector. For example, upon information and belief, the Amazon Echo buds comprise a microphone array and voice detecting accelerometer in each bud. The Accused Products include at least all versions and variants of Amazon earbuds (e.g. the Echo Buds).

48. For example, Amazon has and continues to directly infringe at least claim 11 of the '091 Patent by making, using, offering to sell, selling, and/or importing into the United States products that comprise a system for removing acoustic noise from the acoustic signals, comprising: a receiver that receives at least two acoustic signals via at least two acoustic microphones positioned in a plurality of locations; at least one sensor that receives human tissue vibration information associated with human voicing activity of a user; a processor coupled among the receiver and the at least one sensor that generates a plurality of transfer functions, wherein the plurality of transfer functions includes a first transfer function representative of a ratio of energy of acoustic signals received using at least two different acoustic microphones of the at least two acoustic microphones, wherein the first transfer function is generated in response to a determination that voicing activity is absent from the acoustic signals for a period of time, wherein

the plurality of transfer functions includes a second transfer function representative of the acoustic signals, wherein the second transfer function is generated in response to a determination that voicing activity is present in the acoustic signals for the period of time, wherein acoustic noise is removed from the acoustic signals using the first transfer function and at least one combination of the first transfer function and the second transfer function to produce the denoised acoustic data stream.

49. The Accused Products comprise a system for removing acoustic noise from acoustic signals. For example, the Amazon Echo Buds use beamforming microphones in tandem with a voice detecting accelerometer to reduce noise in voice signals.

50. The Accused Products further comprise a receiver that receives at least two acoustic signals via at least two acoustic microphones positioned in a plurality of locations. For example, upon information and belief, the Echo Buds comprise a receiver that receives signals via a microphone array, with at least two microphones positioned in a plurality of locations.

51. The Accused Products further comprise at least one sensor that receives human tissue vibration information associated with human voicing activity of a user. For example, the Amazon Echo Buds comprise an accelerometer which, upon information and belief, receives human tissue vibration associated with voicing activity.

52. The Accused Products further comprise a processor coupled among the receiver and the at least one sensor that generates a plurality of transfer functions, wherein the plurality of transfer functions includes a first transfer function representative of a ratio of energy of acoustic signals received using at least two different acoustic microphones of the at least two acoustic microphones. For example, on information and belief the Echo Buds comprise a Realtek RTL8763C Bluetooth System on Chip with integrated Audio Codec, NXP Digital Signal

Processor. Upon information and belief, the processor utilizes a microphone array to detect speech with a beamformed microphone which, upon information and belief, includes the generation of at least a plurality of transfer functions, including a first transfer function representative of a ratio of energy of acoustic signals received at different microphones in the microphone array.

53. The Accused Products further comprise a system wherein the first transfer function is generated in response to a determination that voicing activity is absent from the acoustic signals for a period of time. For example, upon information and belief, the Echo Buds generate the first transfer function when the voice detecting accelerometer indicates that voicing activity is absent.

54. The Accused Products further comprise a system wherein the plurality of transfer functions includes a second transfer function representative of the acoustic signals, wherein the second transfer function is generated in response to a determination that voicing activity is present in the acoustic signals for the period of time. For example, upon information and belief, the Echo Buds generate a second transfer function in response to a determination that voicing activity is present, such as based on detection of human tissue vibrations by the voice detecting accelerometer. For example, upon information and belief, each earbud of the Echo Buds comprises a voice detecting accelerometer which detects vibration in human tissue.

55. The Accused Products further comprise a system wherein acoustic noise is removed from the acoustic signals using the first transfer function and at least one combination of the first transfer function and the second transfer function to produce the denoised acoustic data stream. For example, upon information and belief, the Echo Buds remove noise from acoustic signals by applying at least a first transfer function generated when voicing activity is absent, and a transfer function generated by combining the first transfer function generated when voicing activity is absent and a second transfer function generated when voicing activity is detected.

56. Amazon has and continues to indirectly infringe one or more claims of the '091 Patent by knowingly and intentionally inducing others, including Amazon customers and end-users of the Accused Products and products that include the Accused Products, to directly infringe, either literally or under the doctrine of equivalents, by making, using, offering to sell, selling, and/or importing into the United States products that include infringing technology, such as the Amazon Echo Buds.

57. Amazon, with knowledge that these products, or the use thereof, infringe the '091 Patent at least as of the date of this Complaint, knowingly and intentionally induced, and continues to knowingly and intentionally induce, direct infringement of the '091 Patent by providing these products to customers and ultimately to end-users for use in an infringing manner in the United States including, but not limited to, products that include infringing technology, such as the Echo Buds. For example, Amazon's instruction manuals, websites, promotional materials, advertisements, and other information demonstrate to others, including customers, prospective customers, and distributors, how to use the Accused Products in an infringing manner. Upon information and belief, Amazon is aware that the normal and customary use of the Accused Products by customers, distributors, and others would infringe the '091 Patent.

58. Amazon induced infringement by others, including end-users, with the intent to cause infringing acts by others or, in the alternative, with the belief that there was a high probability that others, including end-users, infringe the '091 Patent, but while remaining willfully blind to the infringement.

59. Jawbone has suffered damages as a result of Amazon's direct and indirect infringement of the '091 Patent in an amount to be proved at trial.

60. Jawbone has suffered, and will continue to suffer, irreparable harm as a result of Amazon's infringement of the '091 Patent, for which there is no adequate remedy at law, unless Amazon's infringement is enjoined by this Court. Accordingly, Jawbone seeks a preliminary and permanent injunction enjoining Amazon from making, using, importing, offering to sell, and/or selling the Accused Products, including at least all versions and variants of Amazon Echo Buds.

COUNT II
(Infringement of the '058 Patent)

61. Paragraphs 1 through 44 are incorporated by reference as if fully set forth herein.

62. Jawbone has not licensed or otherwise authorized Amazon to make, use, offer for sale, sell, or import any products that embody the inventions of the '058 Patent.

63. Amazon has and continues to directly infringe the '058 Patent, either literally or under the doctrine of equivalents, without authority and in violation of 35 U.S.C. § 271, by making, using, offering to sell, selling, and/or importing into the United States products that satisfy each and every limitation of one or more claims of the '058 Patent. Upon information and belief, these products include at least the Accused Products, such as those which comprise a microphone array and a voice activity detector. For example, upon information and belief, the Amazon Echo Buds comprise a microphone array and voice detecting accelerometer in each bud. The Accused Products include at least all versions and variants of Amazon earbuds (*e.g.* the Echo Buds).

64. For example, Amazon has and continues to directly infringe at least claim 1 of the '058 Patent by making, using, offering to sell, selling, and/or importing into the United States products that comprise a system for detecting voiced and unvoiced speech in acoustic signals having varying levels of background noise, comprising: at least two microphones that receive the acoustic signals; at least one voicing sensor that receives physiological information associated with human voicing activity; and at least one processor coupled among the microphones and the voicing

sensor, wherein the at least one processor; generates cross correlation data between the physiological information and an acoustic signal received at one of the two microphones; identifies information of the acoustic signals as voiced speech when the cross correlation data corresponding to a portion of the acoustic signal received at the one receiver exceeds a correlation threshold; generates difference parameters between the acoustic signals received at each of the two receivers, wherein the difference parameters are representative of the relative difference in signal gain between portions of the received acoustic signals; identifies information of the acoustic signals as unvoiced speech when the difference parameters exceed a gain threshold; and identifies information of the acoustic signals as noise when the difference parameters are less than the gain threshold.

65. The Accused Products comprise at least two microphones that receive the acoustic signals. For example, each earbud of the Echo Buds comprises at least two outward facing MEMS microphones that receive acoustic signals.

66. The Accused Products further comprise at least one voicing sensor that receives physiological information associated with human voicing activity. For example, the Amazon Echo Buds comprise an accelerometer which, upon information and belief, receives human tissue vibration associated with voicing activity.

67. The Accused Products further comprise at least one processor coupled among the microphones and the voicing sensor. For example, the Echo Buds comprise a Realtek RTL8763C Bluetooth System on Chip with integrated Audio Codec, NXP Digital Signal Processor coupled between the microphones and accelerometers.

68. The Accused Products further comprise a processor which generates cross correlation data between the physiological information and an acoustic signal received at one of

the two microphones. For example, upon information and belief, the Realtek RTL8763C of the Echo Buds generates cross correlation data between the physiological information (e.g. tissue vibration) and an acoustic signal received at one of the two microphones (e.g. an acoustic signal including speech).

69. The Accused Products further comprise a processor which identifies information of the acoustic signals as voiced speech when the cross correlation data corresponding to a portion of the acoustic signal received at the one receiver exceeds a correlation threshold. For example, upon information and belief, the Realtek RTL8763C of the Echo Buds identifies the acoustic signals as speech when the cross correlation data corresponding to a portion of the acoustic signal received at the microphone exceeds a correlation threshold (e.g. a threshold based on vibration and/or acoustic signals).

70. The Accused Products further comprise a processor which generates difference parameters between the acoustic signals received at each of the two receivers, wherein the difference parameters are representative of the relative difference in signal gain between portions of the received acoustic signals. For example, upon information and belief, the Realtek RTL8763C of the Echo Buds generates difference parameters between the acoustic signals received at each MEMS microphone representative of the relative difference in signal gain between portions of the received acoustic signals.

71. The Accused Products further comprise a processor which identifies information of the acoustic signals as unvoiced speech when the difference parameters exceed a gain threshold. For example, the Realtek RTL8763C of the Echo Buds identifies information of the acoustic signals as unvoiced speech (e.g. speech which normally does not cause significant vibration in human tissue) when the difference parameter exceeds a gain threshold.

72. The Accused Products further comprise a processor which identifies information of the acoustic signals as noise when the difference parameters are less than the gain threshold. For example, the Realtek RTL8763C of the Echo Buds identifies acoustic signals as noise (e.g. unwanted background noise) when the difference parameters are less than the gain threshold.

73. Amazon has and continues to indirectly infringe one or more claims of the '058 Patent by knowingly and intentionally inducing others, including Amazon customers and end-users of the Accused Products and products that include the Accused Products, to directly infringe, either literally or under the doctrine of equivalents, by making, using, offering to sell, selling, and/or importing into the United States products that include infringing technology, such as the Amazon Echo Buds.

74. Amazon, with knowledge that these products, or the use thereof, infringe the '058 Patent at least as of the date of this Complaint, knowingly and intentionally induced, and continues to knowingly and intentionally induce, direct infringement of the '058 Patent by providing these products to customers and ultimately to end-users for use in an infringing manner in the United States including, but not limited to, products that include infringing technology, such as the Echo Buds. For example, Amazon's instruction manuals, websites, promotional materials, advertisements, and other information demonstrate to others, including customers, prospective customers, and distributors, how to use the Accused Products in an infringing manner. Upon information and belief, Amazon is aware that the normal and customary use of the Accused Products by customers, distributors, and others would infringe the '058 Patent.

75. Amazon induced infringement by others, including end-users, with the intent to cause infringing acts by others or, in the alternative, with the belief that there was a high probability

that others, including end-users, infringe the '058 Patent, but while remaining willfully blind to the infringement.

76. Jawbone has suffered damages as a result of Amazon's direct and indirect infringement of the '058 Patent in an amount to be proved at trial.

77. Jawbone has suffered, and will continue to suffer, irreparable harm as a result of Amazon's infringement of the '058 Patent, for which there is no adequate remedy at law, unless Amazon's infringement is enjoined by this Court. Accordingly, Jawbone seeks a preliminary and permanent injunction enjoining Amazon from making, using, importing, offering to sell, and/or selling the Accused Products, including at least all versions and variants of Amazon Echo Buds.

COUNT III
(Infringement of the '072 Patent)

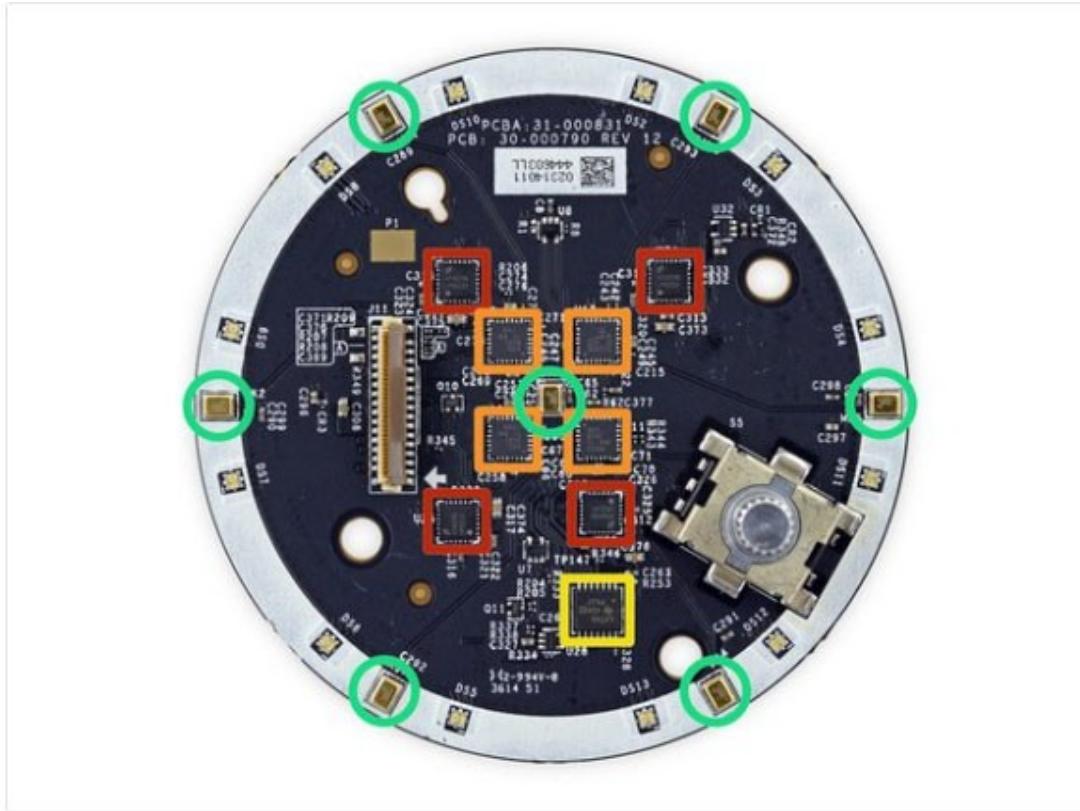
78. Paragraphs 1 through 44 are incorporated by reference as if fully set forth herein.

79. Jawbone has not licensed or otherwise authorized Amazon to make, use, offer for sale, sell, or import any products that embody the inventions of the '072 Patent.

80. Amazon has and continues to directly infringe the '072 Patent, either literally or under the doctrine of equivalents, without authority and in violation of 35 U.S.C. § 271, by making, using, offering to sell, selling, and/or importing into the United States products that satisfy each and every limitation of one or more claims of the '072 Patent. Upon information and belief, these products include at least the Accused Products, such as those which comprise physical and virtual microphone arrays. For example, upon information and belief, the Amazon Echo comprises an array of at least four physical microphones, and an array of two beamformed microphones. The Accused Products include at least all versions and variants of Echo smart speakers, Echo Show smart displays, Fire TV Cube, and Echo buds.

81. For example, Amazon has and continues to directly infringe at least claim 1 of the '072 Patent by making, using, offering to sell, selling, and/or importing into the United States products that practice a method comprising receiving acoustic signals at a physical microphone array and in response outputting a plurality of microphone signals from the physical microphone array; forming a virtual microphone array by generating a plurality of different signal combinations from the plurality of microphone signals, wherein a number of physical microphones of the physical microphone array is larger than a number of virtual microphones of the virtual microphone array; and generating output signals by combining signals output from the virtual microphone array, the output signals including less acoustic noise than the received acoustic signals.

82. Each Accused Product practices a method comprising receiving acoustic signals at a physical microphone array and in response outputting a plurality of microphone signals from the physical microphone array. For example, the Amazon Echo receives signals at a seven-microphone array and, in response, outputs a plurality of microphone signals.



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83. Each Accused Product practices a method of forming a virtual microphone array by generating a plurality of different signal combinations from the plurality of microphone signals, wherein a number of physical microphones of the physical microphone array is larger than a number of virtual microphones of the virtual microphone array. For example, upon information and belief, the Amazon Echo forms an array of six beamformed virtual microphones. For example, the number of physical microphones in the array (seven) is greater than the number of virtual microphones in the array (six).

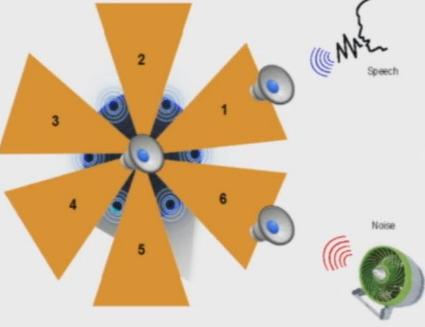
²³ <https://www.ifixit.com/Teardown/Amazon+Echo+Teardown/33953>; Annotations in the image originate from <https://www.ifixit.com/Teardown/Amazon+Echo+Teardown/33953>. Green circles indicate the microphones located in Amazon's Echo product

SIGNAL PROCESSING

Beamforming

Acoustic echo cancellation (AEC)

- Applied to each beam
- Reduces echo of device playback
- Before AEC: 
- After AEC: 



AWS re:Invent

aws

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84. Each Accused Product further practices a method comprising generating output signals by combining signals output from the virtual microphone array, the output signals including less acoustic noise than the received acoustic signals. For example, upon information and belief, the Amazon Echo suppresses acoustic noise by combining the signals output by adjacent beamformed microphones.

85. Amazon has and continues to indirectly infringe one or more claims of the '072 Patent by knowingly and intentionally inducing others, including Amazon customers and end-users of the Accused Products and products that include the Accused Products, to directly infringe, either literally or under the doctrine of equivalents, by making, using, offering to sell, selling,

²⁴ Screen capture of AWS re: Invent 2017: The Science behind the Alexa Prize: Meeting the AI Challenges (ALX320) at 20:07, video available at <https://www.youtube.com/watch?v=pn5QJQZjGpM>

and/or importing into the United States products that include infringing technology, such as the Amazon Echo.

86. Amazon, with knowledge that these products, or the use thereof, infringe the '072 Patent at least as of the date of this Complaint, knowingly and intentionally induced, and continues to knowingly and intentionally induce, direct infringement of the '072 Patent by providing these products to customers and ultimately to end-users for use in an infringing manner in the United States including, but not limited to, products that include infringing technology, such as the Amazon Echo. For example, Amazon's instruction manuals, websites, promotional materials, advertisements, and other information demonstrate to others, including customers, prospective customers, and distributors, how to use the Accused Products in an infringing manner. Upon information and belief, Amazon is aware that the normal and customary use of the Accused Products by customers, distributors, and others would infringe the '072 Patent.

87. Amazon induced infringement by others, including end-users, with the intent to cause infringing acts by others or, in the alternative, with the belief that there was a high probability that others, including end-users, infringe the '072 Patent, but while remaining willfully blind to the infringement.

88. Jawbone has suffered damages as a result of Amazon's direct and indirect infringement of the '072 Patent in an amount to be proved at trial.

89. Jawbone has suffered, and will continue to suffer, irreparable harm as a result of Amazon's infringement of the '072 Patent, for which there is no adequate remedy at law, unless Amazon's infringement is enjoined by this Court. Accordingly, Jawbone seeks a preliminary and permanent injunction enjoining Amazon from making, using, importing, offering to sell, and/or

selling the Accused Products, including at least all versions and variants of Echo smart speakers, Echo Show smart displays, and Fire TV Cube.

COUNT IV
(Infringement of the '213 Patent)

90. Paragraphs 1 through 44 are incorporated by reference as if fully set forth herein.

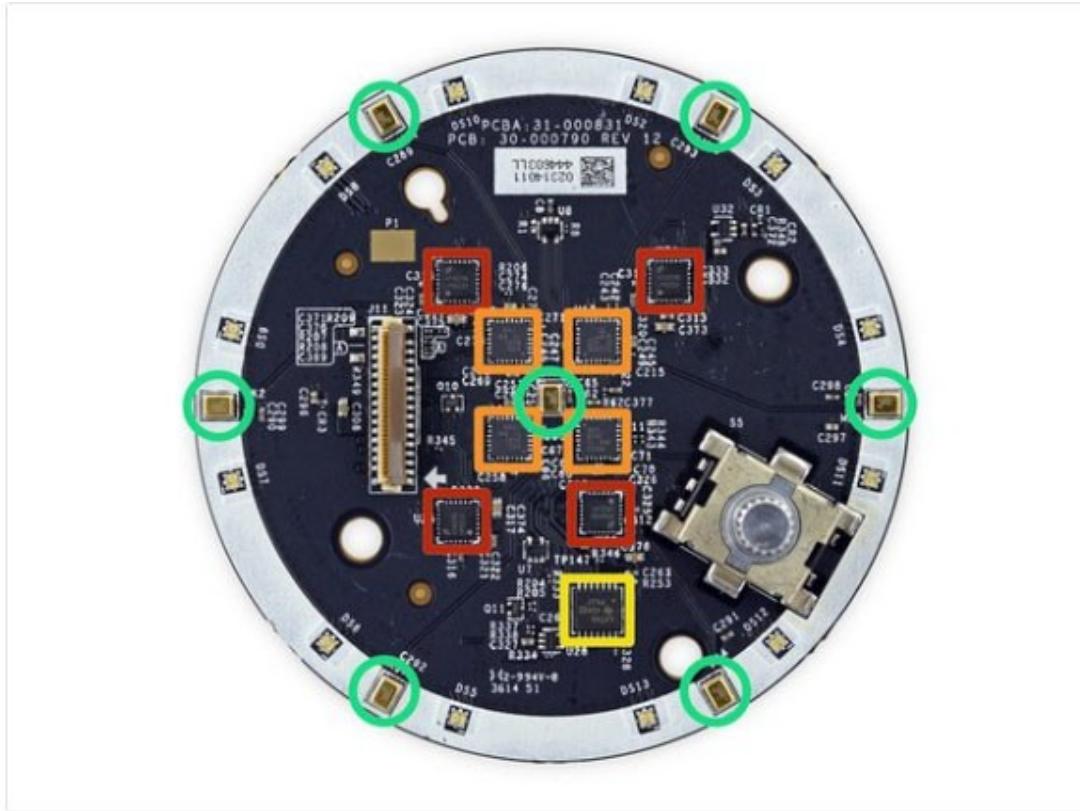
91. Jawbone has not licensed or otherwise authorized Amazon to make, use, offer for sale, sell, or import any products that embody the inventions of the '213 Patent.

92. Amazon has and continues to directly infringe the '213 Patent, either literally or under the doctrine of equivalents, without authority and in violation of 35 U.S.C. § 271, by making, using, offering to sell, selling, and/or importing into the United States products that satisfy each and every limitation of one or more claims of the '213 Patent. Upon information and belief, these products include at least the Accused Products, such as those which comprise an acoustic voice activity detector that includes and utilizes physical and virtual microphone arrays. For example, upon information and belief, the Amazon Echo comprises an acoustic voice activity detector which includes and utilizes an array of beamforming microphones. The Accused Products include at least all versions and variants of Echo smart speakers, Echo Show smart displays, Fire TV Cube, and Echo buds.

93. For example, Amazon has and continues to directly infringe at least claim 1 of the '213 Patent by making, using, offering to sell, selling, and/or importing into the United States products that include an acoustic voice activity detection system comprising: a first virtual microphone comprising a first combination of a first signal and a second signal, wherein the first signal is received from a first physical microphone and the second signal is received from a second physical microphone; a filter, wherein the filter is formed by generating a first quantity by applying a calibration to at least one of the first signal and the second signal, generating a second quantity

by applying a delay to the first signal, and forming the filter as a ratio of the first quantity to the second quantity; and a second virtual microphone formed by applying the filter to the first signal to generate a first intermediate signal and summing the first intermediate signal and the second signal, wherein acoustic voice activity of a speaker is determined to be present when an energy ratio of energies of the first virtual microphone and the second virtual microphone is greater than a threshold value.

94. Each Accused Product comprises a system comprising a first virtual microphone comprising a first combination of a first signal and a second signal, wherein the first signal is received from a first physical microphone and the second signal is received from a second physical microphone. For example, on information and belief, the Amazon Echo forms a first virtual microphone from the outputs of a first and a second physical microphones. For example, upon information and belief, the Amazon Echo comprises at least seven physical microphones which supply inputs for beamformed microphones.



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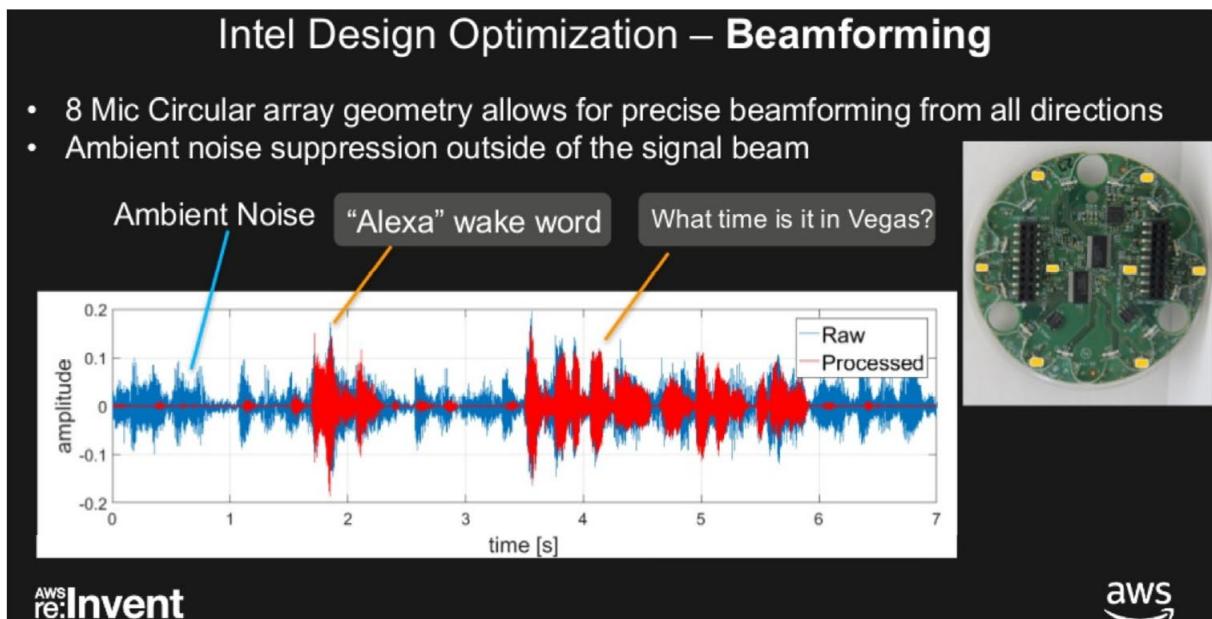
95. Each Accused Product comprises a system comprising a filter, wherein the filter is formed by generating a first quantity by applying a calibration to at least one of the first signal and the second signal, generating a second quantity by applying a delay to the first signal, and forming the filter as a ratio of the first quantity to the second quantity. For example, upon information and belief, the Accused Amazon Echo products form a calibration filter, such as a time and/or frequency domain filter, that describes a relationship for speech between at least a first and second physical microphones by applying a delay to the first signal.

96. Each Accused Product comprises a system comprising a second virtual microphone formed by applying the filter to the first signal to generate a first intermediate signal and summing

²⁵ <https://www.ifixit.com/Teardown/Amazon+Echo+Teardown/33953>; Annotations in the image originate from <https://www.ifixit.com/Teardown/Amazon+Echo+Teardown/33953>. Green circles indicate the microphones located in Amazon's Echo product.

the first intermediate signal and the second signal. For example, upon information and belief, the Amazon Echo forms a second beamformed microphone by applying a calibration filter to the output of at least a first microphone and summing the filtered output of the first microphone with the output of a second microphone.

97. Each of the Accused Products comprises a system wherein acoustic voice activity of a speaker is determined to be present when an energy ratio of energies of the first virtual microphone and the second virtual microphone is greater than a threshold value. For example, on information and belief, the Amazon Echo determines that voicing activity of a speaker is present when a ratio of energies between beamformed microphones is greater than a threshold value associated with the “Alexa” wake word.



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98. Amazon has and continues to indirectly infringe one or more claims of the '213 Patent by knowingly and intentionally inducing others, including Amazon customers and end-

²⁶ <https://www.slideshare.net/AmazonWebServices/designing-farfield-speech-processing-systems-with-intel-and-amazon-alexa-voice-service-alx305-reinvent-2017>

users of the Accused Products and products that include the Accused Products, to directly infringe, either literally or under the doctrine of equivalents, by making, using, offering to sell, selling, and/or importing into the United States products that include infringing technology, such as the Amazon Echo.

99. Amazon, with knowledge that these products, or the use thereof, infringe the '213 Patent at least as of the date of this Complaint, knowingly and intentionally induced, and continues to knowingly and intentionally induce, direct infringement of the '213 Patent by providing these products to customers and ultimately to end users for use in an infringing manner in the United States, including, but not limited to, products that include infringing technology, such as the Amazon Echo. For example, Amazon's instruction manuals, websites, promotional materials, advertisements, and other information demonstrate to others, including customers, prospective customers, and distributors, how to use the Accused Products in an infringing manner. Upon information and belief, Amazon is aware that the normal and customary use of the Accused Products by customers, distributors, and others would infringe the '213 Patent.

100. Amazon induced infringement by others, including end-users, with the intent to cause infringing acts by others or, in the alternative, with the belief that there was a high probability that others, including endusers, infringe the '213 Patent, but while remaining willfully blind to the infringement.

101. Jawbone has suffered damages as a result of Amazon's direct and indirect infringement of the '213 Patent in an amount to be proved at trial.

102. Jawbone has suffered, and will continue to suffer, irreparable harm as a result of Amazon's infringement of the '213 Patent, for which there is no adequate remedy at law, unless Amazon's infringement is enjoined by this Court. Accordingly, Jawbone seeks a preliminary and

permanent injunction enjoining Amazon from making, using, importing, offering to sell, and/or selling the Accused Products, including at least all versions and variants of Echo smart speakers, Echo Show smart displays, and Fire TV Cube.

COUNT V
(Infringement of the '611 Patent)

103. Paragraphs 1 through 44 are incorporated by reference as if fully set forth herein.

104. Jawbone has not licensed or otherwise authorized Amazon to make, use, offer for sale, sell, or import any products that embody the inventions of the '611 Patent.

105. Amazon has and continues to directly infringe the '611 Patent, either literally or under the doctrine of equivalents, without authority and in violation of 35 U.S.C. § 271, at least by using products in the United States that satisfy each and every limitation of one or more claims of the '611 Patent. Upon information and belief, these products include at least the Accused Products, such as those which comprise an acoustic voice activity detector that includes and utilizes physical and virtual microphone arrays. For example, upon information and belief, the Amazon Echo comprises an acoustic voice activity detector which includes and utilizes an array of beamforming microphones. The Accused Products include at least all versions and variants of Echo smart speakers, Echo Show smart displays, Fire TV Cube, and Echo buds.

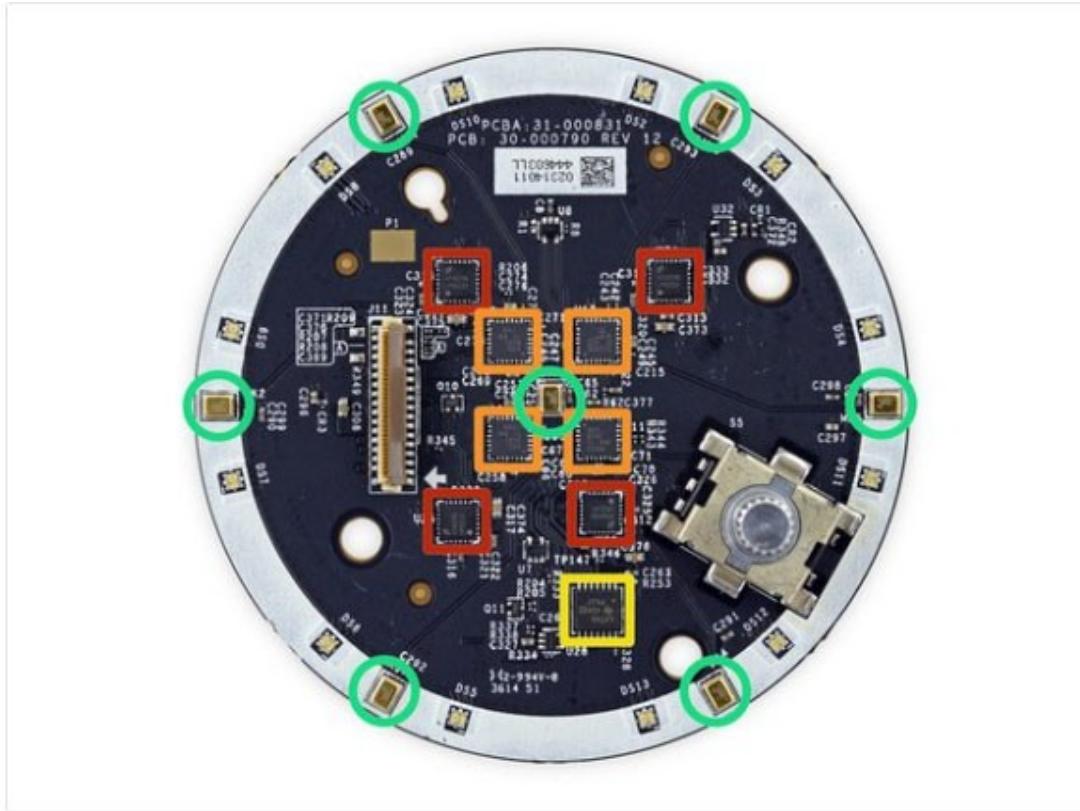
106. For example, Amazon has and continues to directly infringe at least claim 1 of the '611 Patent at least by using products in the United States that perform a method comprising: forming a first virtual microphone by combining a first signal of a first physical microphone and a second signal of a second physical microphone; forming a filter that describes a relationship for speech between the first physical microphone and the second physical microphone; forming a second virtual microphone by applying the filter to the first signal to generate a first intermediate signal, and summing the first intermediate signal and the second signal; generating an energy ratio

of energies of the first virtual microphone and the second virtual microphone; and detecting acoustic voice activity of a speaker when the energy ratio is greater than a threshold value.

107. For example, upon information and belief, Amazon uses the Accused Products during testing and configuration of those products. Upon information and belief, Amazon configures every Accused Product sold in the United States to enable beamforming. For example, upon information and belief, Amazon further uses the Accused Products during marketing demonstrations. For example, Amazon further directly infringes the '611 Patent by remotely using and updating the Accused Products after they are sold to customers.

108. Each Accused Product performs a method comprising forming a first virtual microphone by combining a first signal of a first physical microphone and a second signal of a second physical microphone. For example, on information and belief, the Amazon Echo forms a first virtual microphone from the outputs of a first and a second physical microphones.²⁷ For example, on information and belief, the Amazon Echo forms a first virtual microphone from the outputs of a first and a second physical microphones. For example, upon information and belief, the Amazon Echo comprises at least seven physical microphones which supply inputs for beamformed microphones.

²⁷ https://asru2017.org/Slides/AS17_Keynote_Sainath.pdf



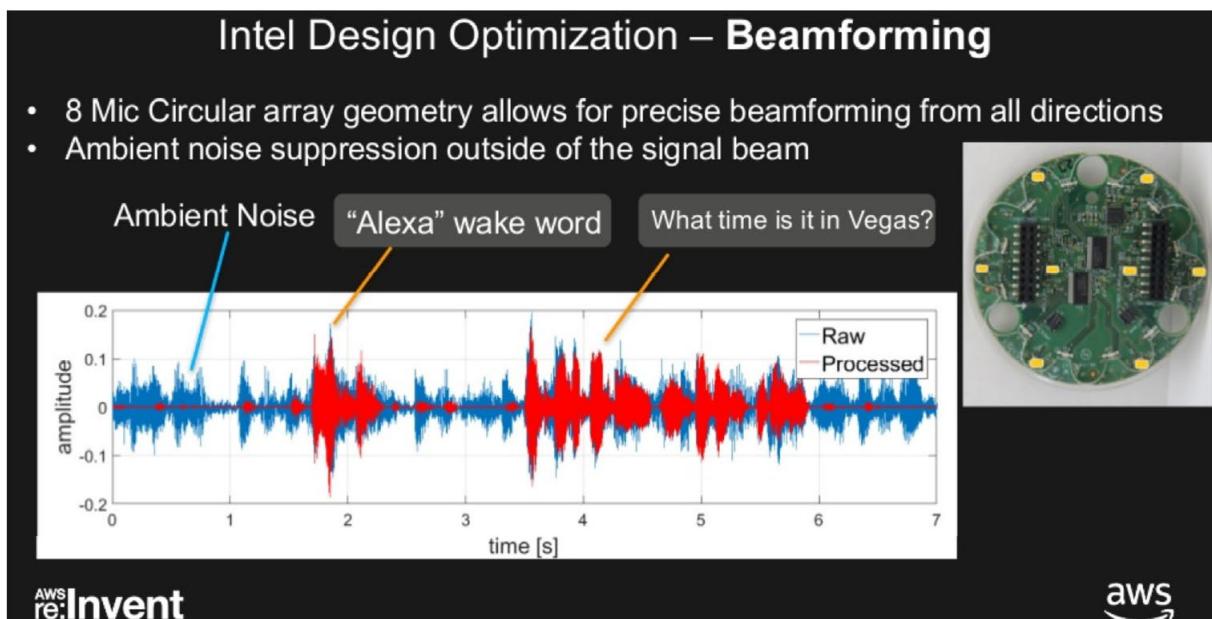
109. Each Accused Product performs a method comprising forming a filter that describes a relationship for speech between the first physical microphone and the second physical microphone. For example, upon information and belief, the Accused Amazon Echo products form a calibration filter, such as a time and/or frequency domain filter, that describes a relationship for speech between at least a first and second physical microphones by applying a delay to the first signal.

110. Each Accused Products performs a method comprising forming a second virtual microphone by applying the filter to the first signal to generate a first intermediate signal and summing the first intermediate signal and the second signal. For example, upon information and

²⁸ <https://www.ifixit.com/Teardown/Amazon+Echo+Teardown/33953>; Annotations in the image originate from <https://www.ifixit.com/Teardown/Amazon+Echo+Teardown/33953>. Green circles indicate the microphones located in Amazon's Echo product.

belief, the Amazon Echo forms a second beamformed microphone by applying a calibration filter to the output of at least a first microphone and summing the filtered output of the first microphone with the output of a second microphone.

111. Each of the Accused performs a method comprising generating an energy ratio of energies of the first virtual microphone and the second virtual microphone; and detecting acoustic voice activity of a speaker when the energy ratio is greater than a threshold value. For example, on information and belief, the Amazon Echo determines that voicing activity of a speaker is present when a ratio of energies between beamformed microphones is greater than a threshold value associated with the “Alexa” wake word.



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112. Amazon has and continues to indirectly infringe one or more claims of the '611 Patent by knowingly and intentionally inducing others, including Amazon customers and end-users of the Accused Products and products that include the Accused Products, to directly infringe,

²⁹ <https://www.slideshare.net/AmazonWebServices/designing-farfield-speech-processing-systems-with-intel-and-amazon-alexa-voice-service-alx305-reinvent-2017>

either literally or under the doctrine of equivalents, by making, using, offering to sell, selling, and/or importing into the United States products that include infringing technology, such as the Amazon Echo.

113. Amazon, with knowledge that these products, or the use thereof, infringe the '611 Patent at least as of the date of this Complaint, knowingly and intentionally induced, and continues to knowingly and intentionally induce, direct infringement of the '611 Patent by providing these products to customers and/or distributors for use in an infringing manner in the United States including, but not limited to, products that include infringing technology, such as the Amazon Echo. For example, Amazon's instruction manuals, websites, promotional materials, advertisements, and other information demonstrate to others, including customers, prospective customers, and distributors, how to use the Accused Products in an infringing manner. Upon information and belief, Amazon is aware that the normal and customary use of the Accused Products by customers, distributors, and others would infringe the '611 Patent.

114. Amazon induced infringement by others, including end-users, with the intent to cause infringing acts by others or, in the alternative, with the belief that there was a high probability that others, including end-users, infringe the '611 Patent, but while remaining willfully blind to the infringement.

115. Jawbone has suffered damages as a result of Amazon's direct and indirect infringement of the '611 Patent in an amount to be proved at trial.

116. Jawbone has suffered, and will continue to suffer, irreparable harm as a result of Amazon's infringement of the '611 Patent, for which there is no adequate remedy at law, unless Amazon's infringement is enjoined by this Court. Accordingly, Jawbone seeks a preliminary and permanent injunction enjoining Amazon from making, using, importing, offering to sell, and/or

selling the Accused Products, including at least all versions and variants of Echo smart speakers, Echo Show smart displays, and Fire TV Cube.

COUNT VI
(Infringement of the '080 Patent)

117. Paragraphs 1 through 44 are incorporated by reference as if fully set forth herein.

118. Jawbone has not licensed or otherwise authorized Amazon to make, use, offer for sale, sell, or import any products that embody the inventions of the '080 Patent.

119. Amazon has and continues to directly infringe the '080 Patent, either literally or under the doctrine of equivalents, without authority and in violation of 35 U.S.C. § 271, by making, using, offering to sell, selling, and/or importing into the United States products that satisfy each and every limitation of one or more claims of the '080 Patent. Upon information and belief, these products include at least the Accused Products, such as those which comprise an array of physical and virtual microphones and suppress noise from received signals. The Accused Products include at least all versions and variants of Echo smart speakers, Echo Show smart displays, Fire TV Cube, and Echo buds.

120. For example, Amazon has and continues to directly infringe at least claim 1 of the '080 Patent by making, using, offering to sell, selling, and/or importing into the United States, a system comprising: a microphone array including a first physical microphone outputting a first microphone signal and a second physical microphone outputting a second microphone signal; a processing component coupled to the microphone array and generating a virtual microphone array including a first virtual microphone and a second virtual microphone, the first virtual microphone including a first combination of the first microphone signal and the second microphone signal, the second virtual microphone including a second combination of the first microphone signal and the second microphone signal, wherein the second combination is different from the first combination,

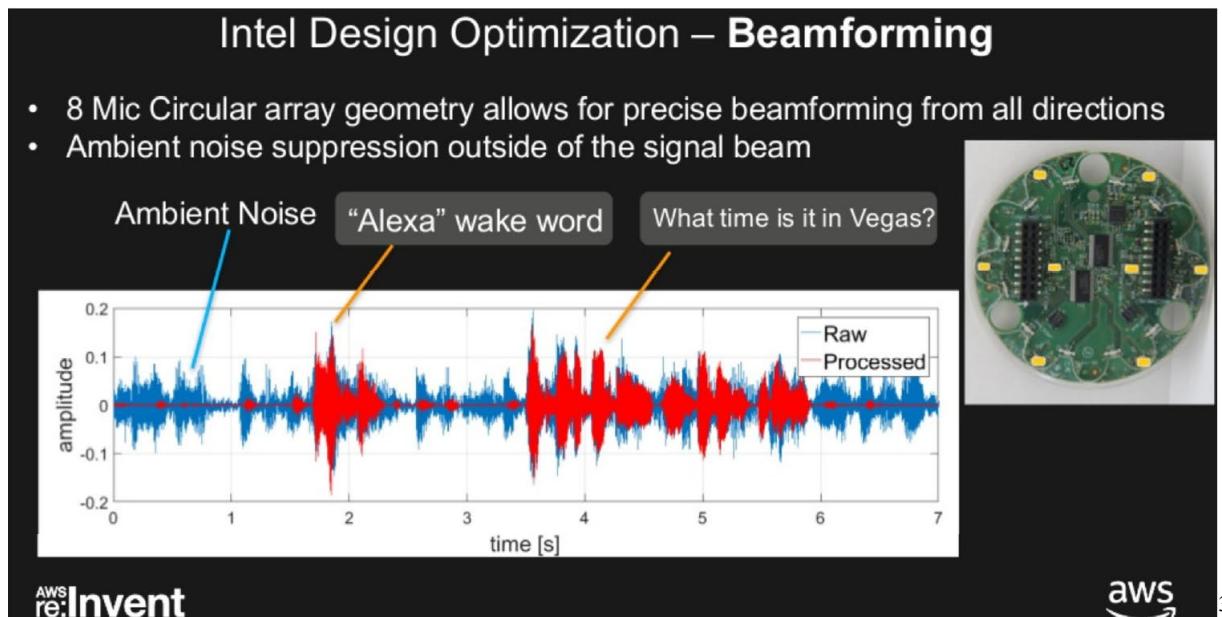
wherein the first virtual microphone and the second virtual microphone have substantially similar responses to noise and substantially dissimilar responses to speech; and an adaptive noise removal application coupled to the processing component and generating denoised output signals by forming a plurality of combinations of signals output from the first virtual microphone and the second virtual microphone, by filtering and summing the plurality of combinations of signals in the time domain, and by a varying linear transfer function between the plurality of combinations of signals, wherein the denoised output signals include less acoustic noise than acoustic signals received at the microphone array.

121. Each Accused Product comprises a microphone array including a first physical microphone outputting a first microphone signal and a second physical microphone outputting a second microphone signal. For example, upon information and belief, the Amazon Echo comprises at least two outward facing microphones, each of which outputs a microphone signal.

122. Each Accused Product comprises a processing component coupled to the microphone array and generating a virtual microphone array including a first virtual microphone and a second virtual microphone. For example, Amazon Echo comprises a DSP that is coupled to the microphone array and, upon information and belief, generates at least two beamformed microphones.

123. Each Accused Product comprises a system wherein the first virtual microphone, including a first combination of the first microphone signal and the second microphone signal, the second virtual microphone, including a second combination of the first microphone signal and the second microphone signal, wherein the second combination is different from the first combination. For example, upon information and belief, each beamformed microphone of the Amazon Echo includes a different combination of signals from the physical microphones of the Echo.

124. Each Accused Product comprises a system wherein the first virtual microphone and the second virtual microphone have substantially similar responses to noise and substantially dissimilar responses to speech. For example, upon information and belief, the beamformed microphones of the Amazon Echo have a substantially similar response to noise and a substantially dissimilar response to speech.



125. Each Accused Product comprises an adaptive noise removal application coupled to the processing component and generating denoised output signals by forming a plurality of combinations of signals output from the first virtual microphone and the second virtual microphone, by filtering and summing the plurality of combinations of signals in the time domain, and by a varying linear transfer function between the plurality of combinations of signals. For example, upon information and belief, the Echo comprises an adaptive noise removal application coupled to a DSP, which generates denoised output signals by forming at least two combinations

³⁰ <https://www.slideshare.net/AmazonWebServices/designing-farfield-speech-processing-systems-with-intel-and-amazon-alexa-voice-service-alx305-reinvent-2017>

of signals from the beamformed microphones, by filtering and summing those combinations in the time domain, and by varying a linear transfer function between those combinations of signals.

126. Each Accused Product comprises a system wherein the denoised output signals include less acoustic noise than acoustic signals received at the microphone array. For example, upon information and belief, the signals denoised by the adaptive noise removal application of the Echo include less noise than the acoustic signals received at the physical microphones.

127. Amazon has and continues to indirectly infringe one or more claims of the '080 Patent by knowingly and intentionally inducing others, including Amazon customers and end-users of the Accused Products and products that include the Accused Products, to directly infringe, either literally or under the doctrine of equivalents, by making, using, offering to sell, selling, and/or importing into the United States products that include infringing technology, such as the Amazon Echo.

128. Amazon, with knowledge that these products, or the use thereof, infringe the '080 Patent at least as of the date of this Complaint, knowingly and intentionally induced, and continues to knowingly and intentionally induce, direct infringement of the '080 Patent by providing these products to customers and ultimately to end-users for use in an infringing manner in the United States including, but not limited to, products that include infringing technology, such as the Echo. For example, Amazon's instruction manuals, websites, promotional materials, advertisements, and other information demonstrate to others, including customers, prospective customers, and distributors, how to use the Accused Products in an infringing manner. Upon information and belief, Amazon is aware that the normal and customary use of the Accused Products by customers, distributors, and others would infringe the '080 Patent.

129. Amazon induced infringement by others, including end-users, with the intent to cause infringing acts by others or, in the alternative, with the belief that there was a high probability that others, including end-users, infringe the '080 Patent, but while remaining willfully blind to the infringement.

130. Jawbone has suffered damages as a result of Amazon's direct and indirect infringement of the '080 Patent in an amount to be proved at trial.

131. Jawbone has suffered, and will continue to suffer, irreparable harm as a result of Amazon's infringement of the '080 Patent, for which there is no adequate remedy at law, unless Amazon's infringement is enjoined by this Court. Accordingly, Jawbone seeks a preliminary and permanent injunction enjoining Amazon from making, using, importing, offering to sell, and/or selling the Accused Products, including at least all versions and variants of Echo products.

COUNT VII
(Infringement of the '357 Patent)

132. Paragraphs 1 through 44 are incorporated by reference as if fully set forth herein.

133. Jawbone has not licensed or otherwise authorized Amazon to make, use, offer for sale, sell, or import any products that embody the inventions of the '357 Patent.

134. Amazon has and continues to directly infringe the '357 Patent, either literally or under the doctrine of equivalents, without authority and in violation of 35 U.S.C. § 271, by making, using, offering to sell, selling, and/or importing into the United States products that satisfy each and every limitation of one or more claims of the '357 Patent. Upon information and belief, these products include at least the Accused Products, such as those which comprise physical and virtual microphone arrays. The Accused Products include at least all versions and variants of Echo smart speakers, Echo Show smart displays, Fire TV Cube, and Echo buds.

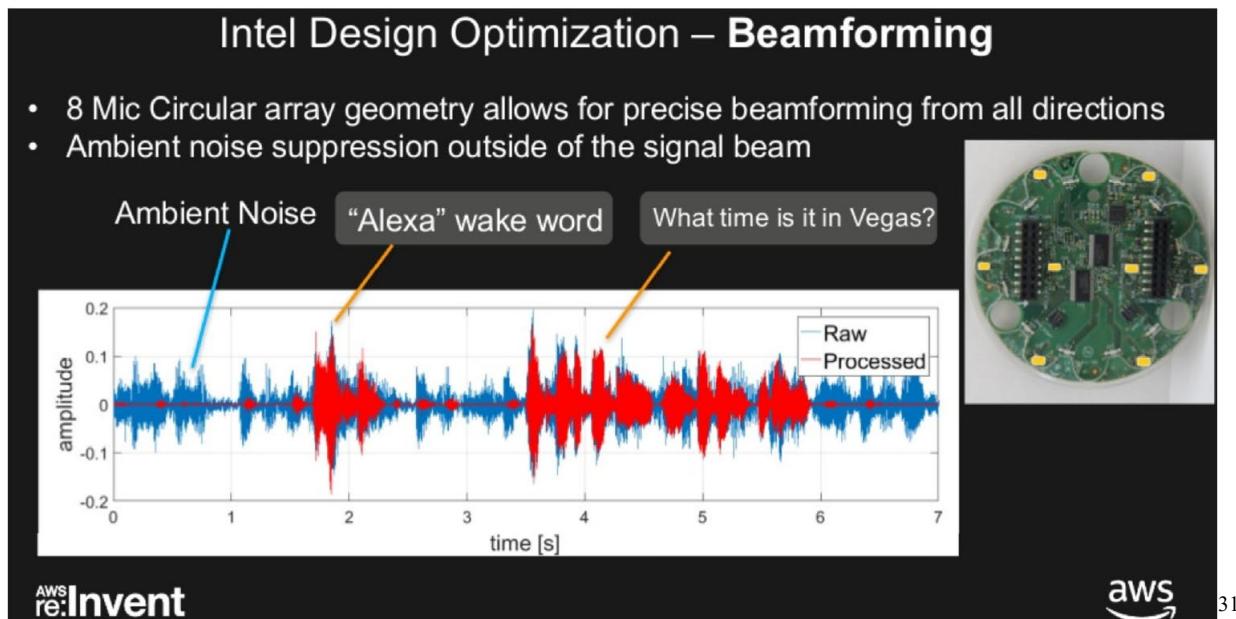
135. For example, Amazon has and continues to directly infringe at least claim 1 of the '357 Patent by making, using, offering to sell, selling, and/or importing into the United States products comprising a first virtual microphone comprising a first combination of a first microphone signal and a second microphone signal, wherein the first microphone signal is generated by a first physical microphone and the second microphone signal is generated by a second physical microphone; a second virtual microphone comprising a second combination of the first microphone signal and the second microphone signal, wherein the second combination is different from the first combination, wherein the first virtual microphone and the second virtual microphone are distinct virtual directional microphones with substantially similar responses to noise and substantially dissimilar responses to speech; and a signal processor coupled with the first and second microphone signals and operative to combine the first and second microphone signals by filtering and summing in the time domain, to apply a varying linear transfer function between the first and second microphone signals, and to generate an output signal having noise content that is attenuated with respect to speech content.

136. Each Accused Product comprises a first virtual microphone comprising a first combination of a first microphone signal and a second microphone signal, wherein the first microphone signal is generated by a first physical microphone and the second microphone signal is generated by a second physical microphone. For example, upon information and belief, the Amazon Echo comprises at least two physical microphones, and a first beamformed microphone comprising signals generated by both microphones.

137. Each Accused Product comprises a second virtual microphone comprising a second combination of the first microphone signal and the second microphone signal, wherein the second combination is different from the first combination. For example, upon information and belief,

the Amazon Echo comprises a second beamformed microphone comprising signals generated by the first and second physical microphones.

138. Each Accused Product comprises a system wherein the first virtual microphone and the second virtual microphone are distinct virtual directional microphones with substantially similar responses to noise and substantially dissimilar responses to speech. For example, upon information and belief, the beamformed microphones of the accused products have similar noise responses and dissimilar speech responses.



139. Each Accused Product comprises a signal processor coupled with the first and second microphone signals and operative to combine the first and second microphone signals by filtering and summing in the time domain, to apply a varying linear transfer function between the first and second microphone signals, and to generate an output signal having noise content that is attenuated with respect to speech content. For example, upon information and belief, each Amazon Echo comprises a DSP, which generates denoised output signals by forming at least two

³¹ <https://www.slideshare.net/AmazonWebServices/designing-farfield-speech-processing-systems-with-intel-and-amazon-alexa-voice-service-alx305-reinvent-2017>

combinations of signals from the beamformed microphones, by filtering and summing those combinations, and by varying a linear transfer function between those combinations of signals.

140. Amazon has and continues to indirectly infringe one or more claims of the '357 Patent by knowingly and intentionally inducing others, including Amazon customers and end-users of the Accused Products and products that include the Accused Products, to directly infringe, either literally or under the doctrine of equivalents, by making, using, offering to sell, selling, and/or importing into the United States products that include infringing technology, such as the Amazon Echo.

141. Amazon, with knowledge that these products, or the use thereof, infringe the '357 Patent at least as of the date of this Complaint, knowingly and intentionally induced, and continues to knowingly and intentionally induce, direct infringement of the '357 Patent by providing these products to customers and ultimately to end-users for use in an infringing manner in the United States including, but not limited to, products that include infringing technology, such as the Echo. For example, Amazon's instruction manuals, websites, promotional materials, advertisements, and other information demonstrate to others, including customers, prospective customers, and distributors, how to use the Accused Products in an infringing manner. Upon information and belief, Amazon is aware that the normal and customary use of the Accused Products by customers, distributors, and others would infringe the '357 Patent.

142. Amazon induced infringement by others, including end-users, with the intent to cause infringing acts by others or, in the alternative, with the belief that there was a high probability that others, including end-users, infringe the '357 Patent, but while remaining willfully blind to the infringement.

143. Jawbone has suffered damages as a result of Amazon's direct and indirect infringement of the '357 Patent in an amount to be proved at trial.

144. Jawbone has suffered, and will continue to suffer, irreparable harm as a result of Amazon's infringement of the '357 Patent, for which there is no adequate remedy at law, unless Amazon's infringement is enjoined by this Court. Accordingly, Jawbone seeks a preliminary and permanent injunction enjoining Amazon from making, using, importing, offering to sell, and/or selling the Accused Products, including at least all versions and variants of Echo products.

COUNT VIII
(Infringement of the '543 Patent)

145. Paragraphs 1 through 44 are incorporated by reference as if fully set forth herein.

146. Jawbone has not licensed or otherwise authorized Amazon to make, use, offer for sale, sell, or import any products that embody the inventions of the '543 Patent.

147. Amazon has and continues to directly infringe the '543 Patent, either literally or under the doctrine of equivalents, without authority and in violation of 35 U.S.C. § 271, by making, using, offering to sell, selling, and/or importing into the United States products that satisfy each and every limitation of one or more claims of the '543 Patent. Upon information and belief, these products include at least the Accused Products, such as those which comprise a microphone array and a voice activity detector. The Accused Products include, but are not limited to, all versions and variants of Amazon earbuds (*e.g.*, Echo Buds series products).

148. For example, Amazon has and continues to directly infringe at least claim 1 of the '543 Patent by making, using, offering to sell, selling, and/or importing into the United States products that comprise a communications system, comprising: a voice detection subsystem configured to receive voice activity signals that includes information associated with human voicing activity, the voice detection subsystem configured to automatically generate control

signals using the voice activity signals; and a denoising subsystem coupled to the voice detection subsystem, the denoising subsystem comprising a microphone array including a plurality of microphones, wherein a first microphone of the array is fixed at a first position relative to a mouth, wherein the first position orients a front of the first microphone towards the mouth, wherein a second microphone of the array is fixed at a second position relative to the mouth, wherein the second position orients a front of the second microphone away from the mouth, such that the second position forms an angle relative to the first position, wherein the angle is greater than zero degrees, the microphone array providing acoustic signals of an environment to components of the denoising subsystem, components of the denoising subsystem automatically selecting at least one denoising method appropriate to data of at least one frequency subband of the acoustic signals using the control signals and processing the acoustic signals using the selected denoising method to generate denoised acoustic signals, wherein the denoising method includes generating a noise waveform estimate associated with noise of the acoustic signals and subtracting the noise waveform estimate from the acoustic signal when the acoustic signal includes speech and noise, wherein the voice detection subsystem is configured to receive the voice activity signals using a sensor independent from the microphone array and to output the control signals generated from the voice activity signals to the denoising system, the denoising system configured to use the control signals to denoise the acoustic signals from the microphone array.

149. The Accused Products comprise a voice detection subsystem configured to receive voice activity signals that includes information associated with human voicing activity, the voice detection subsystem configured to automatically generate control signals using the voice activity signals. For example, the Amazon Echo Buds comprise a speech detecting accelerometer which, upon information and belief, is configured to receive voice activity signals that includes

information associated with human voicing activity, and to automatically generate control signals using the voice activity signals.

150. The Accused Products further comprise a denoising subsystem coupled to the voice detection subsystem, the denoising subsystem comprising a microphone array including a plurality of microphones. For example, the Echo Buds include a denoising system comprising an array of microphones, coupled to the accelerometer (*e.g.* via a DSP and/or processor).

151. The Accused Products further comprise a system wherein a first microphone of the array is fixed at a first position relative to a mouth, wherein the first position orients a front of the first microphone towards the mouth, wherein a second microphone of the array is fixed at a second position relative to the mouth, wherein the second position orients a front of the second microphone away from the mouth such that the second position forms an angle relative to the first position, wherein the angle is greater than zero degrees. For example, a lower microphone of each earbud of the Amazon Echo Buds is oriented towards a user's mouth, an upper microphone is oriented away from a user's mouth, and the angle between the orientation of the microphones is greater than zero degrees.

152. The Accused Products further comprise a system wherein the microphone array provides acoustic signals of an environment to components of the denoising subsystem. For example, the microphone arrays of the Echo Buds provide acoustic signals of an environment (*e.g.* environmental noise) to components of the denoising subsystem (*e.g.* a DSP and/or processor).

153. The Accused Products further comprise a system wherein components of the denoising subsystem automatically selecting at least one denoising method appropriate to data of at least one frequency subband of the acoustic signals using the control signals and processing the acoustic signals using the selected denoising method to generate denoised acoustic signals. For

example, upon information and belief, the Echo Buds further automatically select at least one denoising method appropriate to data of at least one frequency subband using the control signals, such as least mean squares adaptive filtering, and/or other forms of noise suppression, and process the acoustic signals using the selected denoising method to generate denoised acoustic signals.

154. The Accused Products further comprise a system wherein the denoising method includes generating a noise waveform estimate associated with noise of the acoustic signals and subtracting the noise waveform estimate from the acoustic signal when the acoustic signal includes speech and noise. For example, upon information and belief, the Echo Buds suppress noise in received signals by generating a waveform associated with noise (e.g. noise detected by a microphone facing away from a user's mouth) and subtract the noise waveform from the acoustic signal when the signal includes both speech and noise.

155. For example, the Accused Products further comprise a system wherein the voice detection subsystem is configured to receive the voice activity signals using a sensor independent from the microphone array and to output the control signals generated from the voice activity signals to the denoising system, the denoising system configured to use the control signals to denoise the acoustic signals from the microphone array. For example, the Echo Buds comprise a speech detecting accelerometer independent of a microphone array, configured to supply control signals triggering the denoising subsystem when speech is occurring.

156. Amazon has and continues to indirectly infringe one or more claims of the '543 Patent by knowingly and intentionally inducing others, including Amazon's customers and end-users of the Accused Products, to directly infringe, either literally or under the doctrine of equivalents, by making, using, offering to sell, selling, and/or importing into the United States products that include infringing technology, such as the Amazon Echo Buds.

157. Amazon, with knowledge that these products, or the use thereof, infringe the '543 Patent at least as of the date of this Complaint, knowingly and intentionally induced, and continues to knowingly and intentionally induce, direct infringement of the '543 Patent by providing these products to customers and ultimately to end-users for use in an infringing manner in the United States including, but not limited to, products that include infringing technology, such as the Echo Buds. For example, Amazon's instruction manuals, websites, promotional materials, advertisements, and other information demonstrate to others, including customers, prospective customers, and distributors, how to use the Accused Products in an infringing manner. Upon information and belief, Amazon is aware that the normal and customary use of the Accused Products by customers, distributors, and others would infringe the '543 Patent.

158. Amazon induced infringement by others, including end-users, with the intent to cause infringing acts by others or, in the alternative, with the belief that there was a high probability that others, including end-users, infringe the '543 Patent, but while remaining willfully blind to the infringement.

159. Amazon has willfully infringed, and continues to willfully infringe, the '543 Patent by intentionally and deliberately carrying out acts of direct and indirect infringement, while knowing, or taking deliberate steps to avoid learning, that those acts infringe. For example, upon information and belief, Amazon has known of Jawbone's patents, including the '543 Patent, at least since they were marketed to Amazon following Jawbone Inc.'s liquidation.

160. Jawbone has suffered damages as a result of Amazon's direct and indirect infringement of the '543 Patent in an amount to be proved at trial.

161. Jawbone has suffered, and will continue to suffer, irreparable harm as a result of Amazon's infringement of the '543 Patent, for which there is no adequate remedy at law, unless

Amazon's infringement is enjoined by this Court. Accordingly, Jawbone seeks a preliminary and permanent injunction enjoining Amazon from making, using, importing, offering to sell, and/or selling the Accused Products, including at least all versions and variants of the Echo Buds.

DEMAND FOR JURY TRIAL

Plaintiff hereby demands a jury for all issues so triable.

PRAYER FOR RELIEF

WHEREFORE, Jawbone prays for relief against Defendants as follows:

- A. Entry of judgment declaring that Amazon has directly and/or indirectly infringed one or more claims of each of the Patents-in-Suit;
- B. Entry of judgment declaring that Amazon's infringement of the Patents-in-Suit is willful;
- C. Entry of a preliminary injunction enjoining Amazon from making, using, importing, offering to sell, and/or selling the Accused Products;
- D. Entry of a permanent injunction enjoining Amazon from making, using, importing, offering to sell, and/or selling the Accused Products;
- E. An order awarding damages sufficient to compensate Plaintiff for Defendants' infringement of the Patents-in-Suit, but in no event less than a reasonable royalty, including supplemental damages post-verdict, together with pre-judgment and post-judgment interest and costs;
- F. Enhanced damages pursuant to 35 U.S.C. § 284;
- G. Entry of judgment declaring that this case is exceptional and awarding Plaintiff its costs and reasonable attorney fees under 35 U.S.C. § 285;
- H. An accounting for acts of infringement;

I. Such other equitable relief which may be requested and to which the Plaintiff is entitled; and

J. Such other and further relief as the Court deems just and proper.

Dated: November 29, 2021

Respectfully submitted,

/s/ Alfred R. Fabricant

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